Design & Construction Guidelines for Chemical Modification

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Section 215

- **215.02 Materials**
  - Soils shall not be used that contain any of the following:
    - Ca/Mg carbonate >6% by dry weight…ITM 507
    - Loss on ignition >6% by dry weight…..AASHTO T 267
    - Max dry density <95 pcf……AASHTO T 99
    - Soluble sulfate content >1000 ppm……ITM 510

Section 215

- **215.03 Testing and Mix Design**
  - Contactor is responsible for all the laboratory testing.
  - The testing shall be performed by an approved geotechnical consultant. The list is available on the INDOT www.in.gov/indot/files/approvedGeoConsultants.pdf
  - Project personnel will be checking the mixed design and they may contact the Office of Geotechnical Services for help.
  - Mixed design shall be signed by a Professional Engineer.
  - Chemical modifier needs to be from an approved source and the list is available on the Materials Management website: www.in.gov/indot/div/mt/appmat/pubs/apl57.pdf

Section 215

- **215.05 & 215.06 Weather Limitations and Preparation of Soils**
  - Chemical soils modification shall be used when soil temperature is 45º F or above. Soils shall be prepared in accordance with Section 203.
  - Aggregates/rocks larger than 3 inches shall be removed.

Section 215

- **215.08 Mixing**
  - Soil chemicals shall be mixed thoroughly.
  - 100 percent should pass a 1 inch sieve.
  - 60 percent shall pass No. 4 sieve.
  - Moisture shall be at or above OMC based AASHTO T 99 of chemical soils mixture.
  - The mixing depth shall be 8 inches or 14 inches deep (as specified).

215.07 Lime Slurry Spreading

Lime slurry spreading in urban area.

215.07 Lime Slurry Spreading

215.07 Dry Lime Spreading

215.07 Dry Lime Spreading

Rotary Speed Mixer

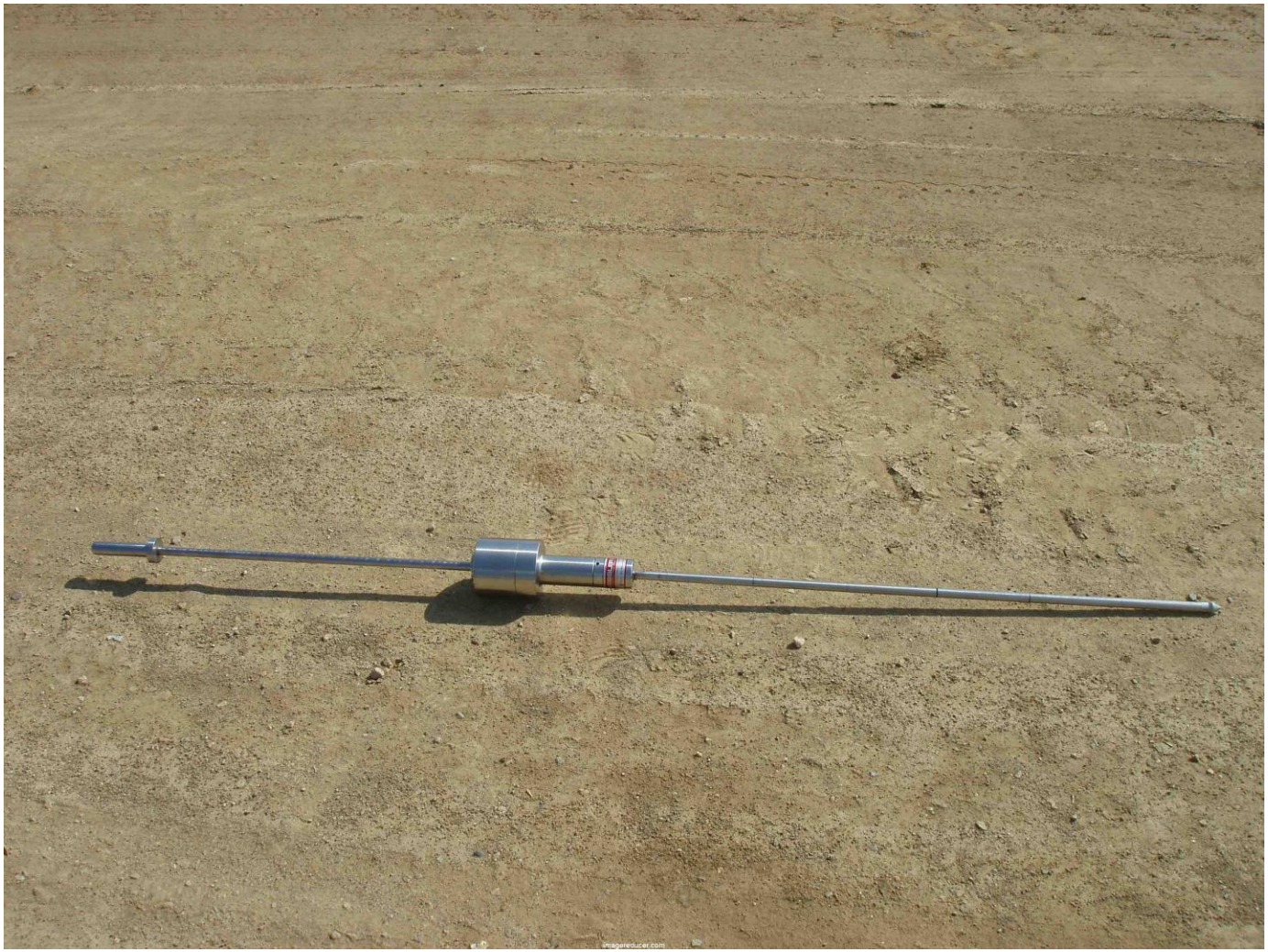
Lime Modified Soil

Mixing, compaction and grading of lime modified soil.

Items to be Checked During Mixing

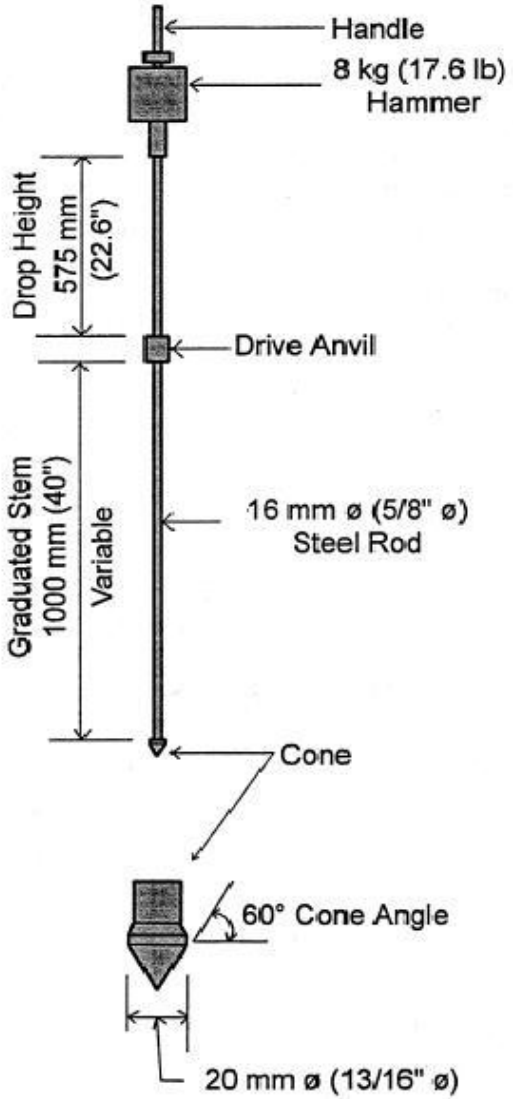
- **Chemical and soils mixers should be checked for the following requirements:**
  - 100 percent shall pass a 1 inch sieve.
  - 60 percent shall pass No. 4 sieve.
  - Mixing depth shall be checked by phenolphthalein.
  - Moisture content of mixture shall be equal or greater than OMC of chemical modified soils.
  - Caution: No microwave and/or moisture probe tests.

Fully Assembled DCP

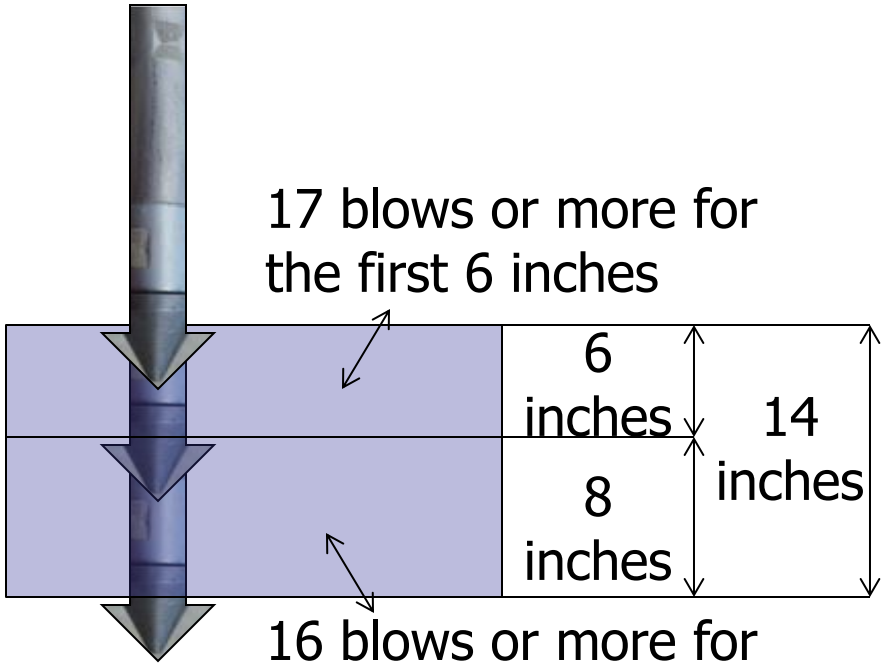


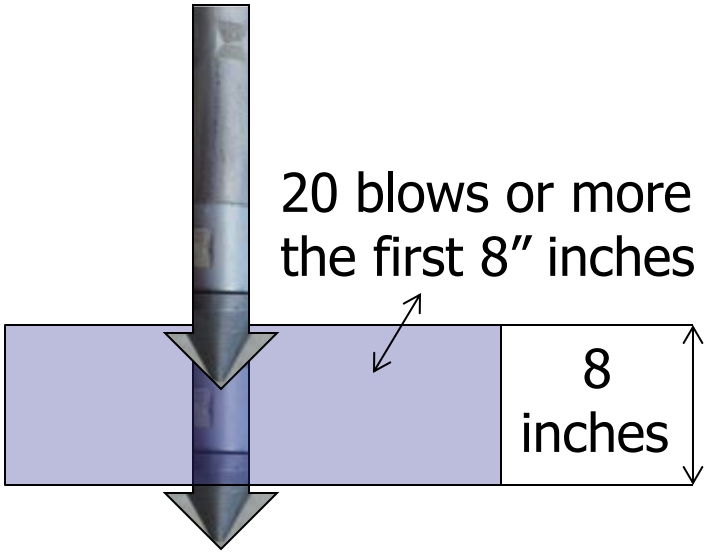
Fully assembled DCP on lime modified subgrade.

Dynamic Cone Penetrometer (DCP)



DCP Test in chemically modified soils





Chemically Modified Soils

DCP tests in chemically modified subgrade.

Disposable DCP cone slides on the end of attachment.

215.09 Compaction

- **Acceptance testing shall be performed with a DCP in accordance with ASTM D 6951. The chemically modified soil lift shall meet the following requirements for compaction:**
  - A minimum DCP blow count of 17 for the top 6 inches of a 14 inch lift.
  - A minimum DCP blow count of 16 for the bottom 8 inches of a 14 inch lift.
  - A minimum DCP blow count of 20 for an 8 inch lift.
  - A minimum of 1 passing test for each 1,500 feet of chemically modified soil for each two-lanes of pavement.

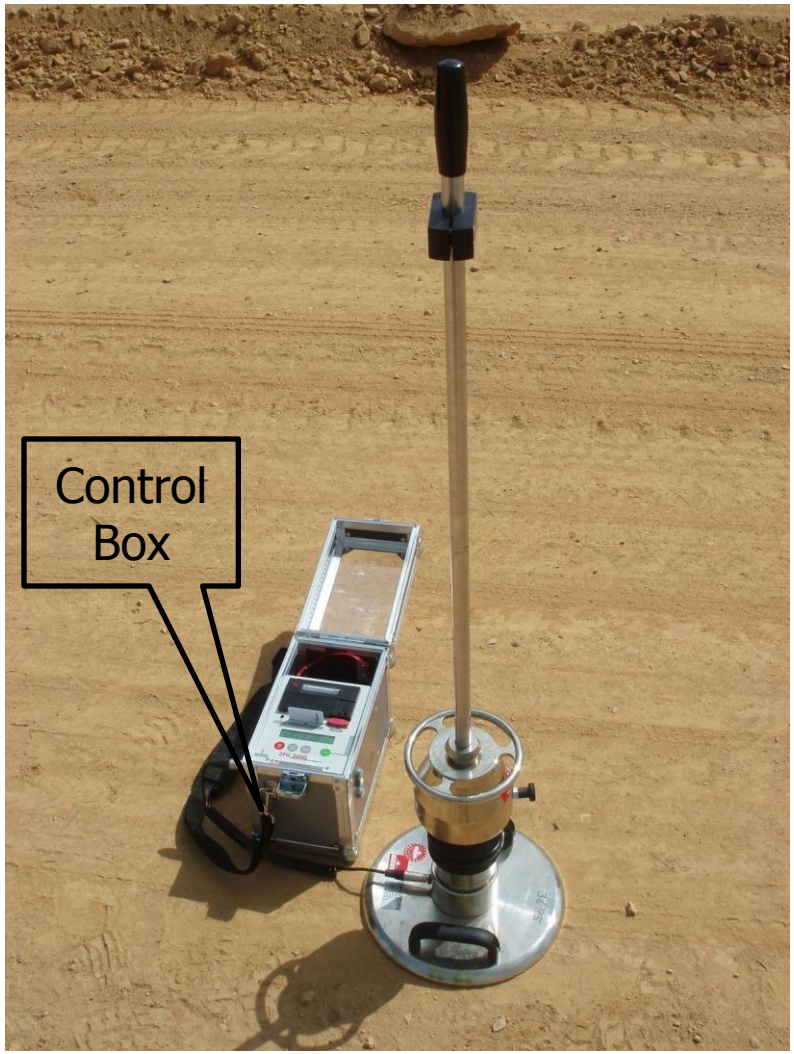
*Suggestion: Terminate DCP test at 25 blow counts even if DCP does not penetrate to a specified depth of 6 or 8 inches in cement modified soils.

Light Weight Deflectometer (LWD)

ITM 508

ASTM E 2583- 07

ZORN model ONLY



LWD Test

- **Acceptance test for compaction of chemically modified subgrade shall meet the following:**
  - Lime modified subgrade shall be a maximum of 0.30 mm or less,
  - Cement modified subgrade shall be a maximum of 0.27 mm or less, or

    select a test pad 100 feet by 20 feet.
- **Field tests required during construction:**
  - Four DCP passing tests shall be performed randomly through out the test pad.
  - DCP tests shall meet the requirement of Sec 215.09.
  - Ten randomly selected LWD tests (deflection).
  - Average deflection from the 10 LWD tests shall be used to perform compaction control.

Acceptance Testing

LWD & DCP Test

Chemically modified soils .....One test per1400 CYD for two lane road.

Chemically modified soils shall be proofrolled.

Section 913

- **913.04 Lime**
  - (b) Lime for Soil Modification
  - Hydrated lime, quicklime, or a lime by-product used for soil modification shall be approved in accordance with ITM 806, Procedure P (Approved lime source list on OMM web site)

Indiana Test Methods

- **ITM 506**
  - Smaller sample and stove top only for moisture
- **ITM 509**
  - Field determination of strength using Dynamic Cone Penetrometer
- **ITM 508-10T**
  - LWD field determination of deflection (only for aggregates)

Recommendations

- Chemically modified soils should be covered with pavement, as mixed design is not adequate for freeze and thaw cycle.
- Soils, water and lime soluble sulfate should be checked.
- The grade should be checked prior to chemical modification.
- Where grade is in cut or in transition and the soils moisture below the subgrade is greater than 5% over OMC, foundation improvement should be performed prior to the subgrade construction.
- No microwave or moisture probe tests should be performed on chemically modified soils.

Questions?